Disclosures

I currently have no relationships of any kind with any company whose products or services in any way relate to the practice of medicine, medical education, or research.
Outline

- Rationale for preoperative assessment
- Algorithmic approach
- Preoperative testing
- Special populations
- Medication management
Surgery – Risky Business

- Surgery inherently carries cardiovascular risk because of the physiologic impacts
  - Blood loss
  - Fluid shifts
  - Tachy-/bradycardia
  - Hyper-/hypotension

- Approximately 1 out of every 33 patients undergoing major non-cardiac surgery will experience
  - Death,
  - Acute MI, or
  - Ischemic stroke
Your Role – Assess Risk!

- Patient- and surgery-specific factors influence risk of cardiovascular events
- When performing a preoperative evaluation, you must
  - Determine the patient’s risk
  - Review pertinent tests that influence the risk calculation
  - Optimize medications that can mitigate risk
- Guidelines established by American College of Cardiology (ACC) and American Heart Association (AHA) are most commonly used
  - Latest iteration was released in 2014
Applying the Protocol

- At Lancaster General Health/Penn Medicine we use an algorithmic approach to preoperative clearance based on the 2014 ACA/AHA protocol

- Dr. Neil Clark at LGHP-The Heart Group has been instrumental in developing an EHR-based tool to provide a clear approach to pre-operative clearance

- Use of the tool during its first year led to significantly fewer stress tests
  - 2,384 uses by PCPs -> 2% stress testing
  - 2,298 uses by cardiology -> 11% stress testing
### Step 1 – Urgency of Procedure

- The 2014 ACC/AHA guidelines established time frames for urgency of procedures

<table>
<thead>
<tr>
<th>Urgency</th>
<th>Delay Impact</th>
<th>Implication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency</td>
<td>Life or limb threatened if not proceeding in under 6 hours</td>
<td>Proceed to surgery with appropriate monitoring of clinical risk factors</td>
</tr>
<tr>
<td>Urgent</td>
<td>Life or limb threatened if not proceeding within 6 to 24 hours</td>
<td>May have time for limited workup before proceeding to surgery</td>
</tr>
<tr>
<td>Time-sensitive</td>
<td>Delay of 1 to 6 weeks may negatively impact outcome</td>
<td>Expedited evaluation of clinical risk factors in the outpatient setting would be appropriate</td>
</tr>
<tr>
<td>Elective</td>
<td>Procedure could be delayed up to a year without negative impact</td>
<td>Routine outpatient preoperative evaluation per guidelines</td>
</tr>
</tbody>
</table>
Step 2 – Assess for Acute Coronary Syndrome

- Evidence of Acute Coronary Syndrome (ACS) during the preoperative evaluation requires cardiology evaluation and treatment according to current clinical practice guidelines
  - Unstable angina
  - Non-ST elevation myocardial infarction (NSTEMI)
  - ST elevation myocardial infarction (STEMI)

- Additionally, cardiology consultation should be considered in patients with
  - Decompensated heart failure
  - Unstable arrhythmias
  - Hemodynamically important valvular heart disease (aortic stenosis in particular)
Step 3 – Estimate Cardiac Risk - Surgery

- Surgical risk of cardiac death or nonfatal MI impacts the need for further evaluation prior to the procedure

<table>
<thead>
<tr>
<th>High risk (&gt;5%)</th>
<th>Intermediate risk (1-5%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency surgery (2-5x higher risk than elective procedures)</td>
<td>Orthopedic surgery</td>
</tr>
<tr>
<td>Aortic surgery and other major vascular surgeries</td>
<td>Intraperitoneal &amp; intrathoracic surgery</td>
</tr>
<tr>
<td>Anticipated prolonged surgical procedures with large fluid shifts and/or blood loss</td>
<td>Carotid endarterectomy</td>
</tr>
<tr>
<td></td>
<td>Head &amp; neck surgery</td>
</tr>
<tr>
<td></td>
<td>Prostate surgery</td>
</tr>
</tbody>
</table>
Step 3 – Estimate Cardiac Risk - Surgery

- Low risk procedures typically do not require further testing prior to procedures

- **Low risk (<1% risk of MI/death)**
  - Cataract & ophthalmologic
  - Inguinal hernia
  - Breast masses
  - Endoscopic procedures
  - Angiography
  - Oral/maxillary
  - Superficial/cosmetic procedures
  - Podiatry
Multiple calculators exist that weigh specific conditions in terms of impact on Major Adverse Cardiac Events (MACE)

- Death
- Acute MI
- Need for revascularization procedure

On-line risk calculators predict the likelihood of a (MACE)

- Low risk (MACE <1%) → may proceed to surgery
- Elevated risk (MACE =>1%) → determine functional status

The 2014 ACC/AHA clinical guidelines suggest use of:

- Revised Cardiac Risk Index (RCRI) or
- American College of Surgeons NSQIP risk calculator or
- Gupta Myocardial Infarction/Cardiac Arrest calculator (MICA)
Step 4 – Estimate Cardiac Risk - RCRI

- Revised Cardiac Risk Index was proposed in 1999 and has been validated in multiple studies since
- Points are assigned to factors that impact cardiac risk
- The total points for a patient = an estimated risk of a MACE
  - High risk or intraperitoneal/intrathoracic surgery
  - History of ischemic heart disease
  - History of heart failure
  - History of cerebrovascular disease
  - Insulin-dependent diabetes
  - Preoperative creatinine $\geq 2.0$

- Risk depends on total points
  - 0 = 0.4%
  - 1 = 0.9%
  - 2 = 6.6%
  - 3+ = 11%

# Revised Cardiac Risk Index for Pre-Operative Risk

Estimates risk of cardiac complications after surgery.

<table>
<thead>
<tr>
<th>Pearls/Pitfalls</th>
<th>High-risk surgery</th>
<th>History of ischemic heart disease</th>
<th>History of congestive heart failure</th>
<th>History of cerebrovascular disease</th>
<th>Pre-operative treatment with insulin</th>
<th>Pre-operative creatinine &gt;2 mg/dL / 176.8 μmol/L</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yes +1</td>
<td>Yes +1</td>
<td>No 0</td>
<td>No 0</td>
<td>No 0</td>
<td>No 0</td>
</tr>
</tbody>
</table>

1 points

**Class II Risk**

0.9% Risk of Major Cardiac Event
Step 4 – Estimate Cardiac Risk – ACS-NSQIP

- American College of Surgeons National Surgical Quality Improvement Project risk calculator was developed in 2013 for a more comprehensive, predictive model
  - Requires input of the surgical procedure and 20 patient factors
  - Excellent for predicting morbidity and mortality
  - More cumbersome, requiring CPT code for procedure

### ACS NSQIP Surgical Risk Calculator

**Procedure:** 27447 - Arthroplasty, knee, condyle and plateau; medial AND lateral compartments with or without patella resurfacing (total knee arthroplasty)

**Risk Factors:**
- 75-84 years
- Partially dependent functional status
- Diabetes (insulin)
- HTN
- Dyspnea with moderate exertion
- Smoker
- Cholesterol

### Outcomes

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Your Risk</th>
<th>Average Risk</th>
<th>Chance of Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious Complication</td>
<td>8.2%</td>
<td>3.8%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Any Complication</td>
<td>9.7%</td>
<td>4.4%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Pneumonia</td>
<td>0.6%</td>
<td>0.2%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Cardiac Complication</td>
<td>0.5%</td>
<td>0.2%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Surgical Site Infection</td>
<td>1.3%</td>
<td>0.7%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Urinary Tract Infection</td>
<td>2.1%</td>
<td>0.8%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Venous Thromboembolism</td>
<td>1.7%</td>
<td>1.3%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Renal Failure</td>
<td>0.3%</td>
<td>0.1%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Re-admission</td>
<td>6.3%</td>
<td>3.1%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Return to OR</td>
<td>1.4%</td>
<td>0.9%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Death</td>
<td>0.2%</td>
<td>0.1%</td>
<td>Above Average</td>
</tr>
<tr>
<td>Discharge to Nursing or Rehab Facility</td>
<td>70.0%</td>
<td>23.2%</td>
<td>Above Average</td>
</tr>
</tbody>
</table>

**Predicted Length of Hospital Stay:** 4.8 days
Step 4 – Estimate Cardiac Risk - MICA

- Gupta Myocardial Infarction/Cardiac Arrest calculator (MICA) was developed in 2011 to estimate risk of perioperative MACE based on the American College of Surgeons National Surgical Quality Improvement Program (NSQIP) dataset
  - Age
  - American Society of Anesthesiologists’ class (1 to 5)
  - Preoperative creatinine >= 1.5
  - Preoperative functional status (0 = independent, 2 = total dependent)
  - Type of surgery (21 options listed)

- [http://www.surgicalriskcalculator.com/miocardiacarrest](http://www.surgicalriskcalculator.com/miocardiacarrest)
**Perioperative Myocardial Infarction or Cardiac Arrest Risk Calculator**

<table>
<thead>
<tr>
<th>Age</th>
<th>Enter actual age in years</th>
<th>Estimated risk probability for perioperative MICA: 0.36%</th>
</tr>
</thead>
<tbody>
<tr>
<td>75</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ASA Class</th>
<th>Enter 1 - 5 for American Society of Anesthesiologists' Class</th>
<th>ASA Classification:</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td></td>
<td>1. A normal healthy patient.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. A patient with mild systemic disease.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. A patient with severe systemic disease.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. A patient with severe systemic disease that is a constant threat to life.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>5. A moribund patient who is not expected to survive without the operation.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Creatinine (preoperative)</th>
<th>Enter 2 for missing value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 for &gt;=1.5 mg/dl</td>
</tr>
<tr>
<td></td>
<td>0 for &lt;1.5 mg/dl</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Functional Status (preoperative)</th>
<th>Enter 2 for patients with totally dependent functional status</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 for patients who have partially dependent functional status</td>
</tr>
<tr>
<td></td>
<td>0 for those who are totally independent</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure:</th>
<th>Enter 1 for Anorectal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 for Aortic</td>
</tr>
<tr>
<td></td>
<td>3 for Bariatric</td>
</tr>
<tr>
<td></td>
<td>4 for Brain</td>
</tr>
<tr>
<td></td>
<td>5 for Breast</td>
</tr>
<tr>
<td></td>
<td>6 for Cardiac</td>
</tr>
<tr>
<td></td>
<td>7 for ENT (except thyroid/parathyroid)</td>
</tr>
<tr>
<td></td>
<td>8 for Foregut/Hepatopancreatobiliary</td>
</tr>
<tr>
<td></td>
<td>9 for Gallbladder, appendix, adrenal and spleen</td>
</tr>
<tr>
<td></td>
<td>10 for Hernia (ventral, inguinal, femoral)</td>
</tr>
<tr>
<td></td>
<td>11 for Intestinal</td>
</tr>
<tr>
<td></td>
<td>12 for Neck (Thyroid and Parathyroid)</td>
</tr>
<tr>
<td></td>
<td>13 for Obstetric/Gynecologic</td>
</tr>
<tr>
<td></td>
<td>14 for Orthopedic and non-vascular Extremity</td>
</tr>
<tr>
<td></td>
<td>15 for Other abdominal</td>
</tr>
<tr>
<td></td>
<td>16 for Peripheral Vascular</td>
</tr>
<tr>
<td></td>
<td>17 for Skin</td>
</tr>
<tr>
<td></td>
<td>18 for Spine</td>
</tr>
<tr>
<td></td>
<td>19 for non-esophageal Thoracic</td>
</tr>
<tr>
<td></td>
<td>20 for Vein</td>
</tr>
<tr>
<td></td>
<td>21 for Urology</td>
</tr>
</tbody>
</table>
Step 5 – Functional Capacity

- Patient with a risk of a MACE $\geq 1\%$ should be evaluated for functional capacity
- Determine how many METs (metabolic equivalents) the patient is capable of completing
  - 1 MET is defined as 3.5 mL oxygen uptake/kg per min, which is the resting oxygen uptake in a sitting position
- Patients with functional capacity $<4$ METs may require additional cardiac testing
- Patient with functional capacity of METs $4+$ → proceed with surgery
Step 5 – Functional Capacity - METs

**MET scale**

1. Sitting
2. Walking in home
3. Walking one block; bowling; light housework
4. Walking up one flight of stairs or 4 blocks; vigorous cleaning
5. Walking up two flights of stairs
6. Hiking
7+. Active sports
Step 6 – Consider Further Testing

- For patients with elevated MACE risk score (over 1%) with low functional capacity (METs < 4) discuss next steps with patient
  - Will further testing impact decision making?
  - Will further testing impact perioperative care?

- If the answer is “no” to both questions then may
  - Proceed with surgery
  - Attempt alternate treatment strategies
  - Pursue palliation
Step 7 – Cardiac Testing

- If the answer is “yes” to either question then pursue pharmacologic stress testing
  - Consider dobutamine echocardiogram → can assess cardiac function
  - Cardiac CTA may be reasonable alternative (cheaper but leads to more procedures)
  - Remember cost of procedure! Stress test may cost $2,000-$3,000 or more

- Results dictate clearance
  - Normal results → proceed to surgery
  - Abnormal or equivocal results → refer to Cardiology
Preoperative Testing – EKG

- Routine preoperative EKG is NOT useful for asymptomatic patients undergoing low-risk surgical procedures (Level of Evidence B)

- Preoperative EKG is reasonable for patients with known CAD or significant structural heart disease EXCEPT for low-risk surgical procedures (LOE B)
Echocardiogram is reasonable to evaluate LV function in:
- Patients with dyspnea of unknown origin (LOE C)
- Patients with heart failure with worsening clinical status (LOE C)
- Stable patients with LV dysfunction but no echo within one year (LOE C)

Routine preoperative assessment of LV function is not recommended (LOE C)

Echocardiogram should be performed in patients with known moderate or severe valvulvar disease who have not had evaluation within one year (LOE C)
Preoperative Testing – CXR

- Chest radiographs are likely not necessary in most patients undergoing noncardiac elective surgery
  - Previous meta-analysis demonstrated only 1% of CXRs had unexpected findings with only 0.1% affecting management of the patient

- Populations that may benefit from lung imaging include
  - Known cardiopulmonary disease
  - Age >60
Patients with certain risk factors have increased odds of postoperative pulmonary complications
- COPD – 6-9% rate of significant complication
  - No absolute lung function level that would preclude surgery
- Tobacco use – higher risk for smokers with >20 pack-year history
  - Ideally should stop 4+ weeks prior to surgery
  - Cessation <4 weeks prior does not appear to increase risk
- Obstructive sleep apnea – 2-4x higher risk for complications
  - Consider screening for OSA using a validated tool (STOP-Bang questionnaire)
  - Attempt to optimize treatment prior to surgery
Use of a risk calculator can help guide discussions with the patient regarding pulmonary complications

ARISCAT preoperative pulmonary risk index

Gupta Postoperative Respiratory Failure (PRF) Risk Calculator
Special Populations – Pulmonary Hypertension

- Patients with pulmonary hypertension should continue on all therapies that treat that condition unless contraindicated
  - phosphodiesterase type 5 inhibitors
  - soluble guanylate cyclase stimulators
  - endothelin receptor antagonists
  - prostanoids

- Evaluation by a pulmonary hypertension specialist may be beneficial before surgery (LOE C)
Special Populations – Valvular Heart Disease

- Patients with moderate or greater degrees of valvular stenosis or regurgitation should have an echocardiogram if:
  - no echo within 1 year or
  - significant change in clinical status or physical exam

- Elective elevated-risk non-cardiac surgery is reasonable with close hemodynamic monitoring in patients with ASYMPTOMATIC
  - Severe aortic stenosis (LOE B)
  - Severe mitral regurgitation (LOE C)
  - Severe aortic regurgitation with preserved ejection fraction (LOE C)
- Percutaneous Coronary Intervention (PCI) should not be pursued solely for the purpose of reducing preoperative cardiac risk.

- If non-cardiac surgery is time sensitive, consider a PCI that may reduce the delay until surgery:
  - Balloon angioplasty → delay 14 days (LOE C)
    - Fewer than 5% PCIs involve balloon without stenting
  - Bare-metal stent → delay 30 days (LOE B)
  - Drug-eluting stent → delay 180 to 365 days (LOE C)
Drug-Eluting Stents (DES) have increased rate of in-stent stenosis for at least the first year after placement

- Premature cessation of platelet P2Y_{12} receptor blocker is the greatest predictor of stent thrombosis
- Cessation of dual antiplatelet therapy leads to a 30-50x increased risk of stent thrombosis

- If possible, elective surgery should be delayed for one year to allow continuous use of dual antiplatelet therapy
- If the risk of surgical delay is greater than the risk of DES thrombosis then proceed after 180 days

- If platelet P2Y_{12} receptor blocker therapy must be discontinued for surgery,
  - Continue aspirin
  - Resume platelet P2Y_{12} receptor blocker ASAP after surgery (LOE C)
Medication Management

- Over ½ of surgical patients take medications that could impact surgical outcomes

- Medications affecting bleeding
  - Platelet P2Y_{12} receptor blocker
  - ASA
  - Anticoagulants
  - NSAIDs

- Cardiovascular medications
  - Beta blockers
  - Alpha 2 agonists
  - ACE inhibitors / ARBs
  - Diuretics
  - Cholesterol modifying agents

- Pulmonary medications
  - Inhaled therapies
  - Leukotriene inhibitors

- Endocrine medications
  - Glucocorticoids
  - Diabetes medications
  - Oral contraceptives

- Psychotropic medications
  - SSRIs
  - Mood stabilizers

- Rheumatologic medications
  - DMARDs
Medication Management – Platelet P2Y$_{12}$ receptor blocker

- Thienopyridines should be held the minimal amount of time possible for the surgery
  - Clopidogrel (Plavix) Five days
  - Prasugrel (Effient) Seven days
  - Ticagrelor (Brilinta) Three to five days

- Clopidogrel, if stopped, should be restarted with a loading dose of 300-600 mg once post-operative bleeding has stopped
Medication Management – ASA

- Antiplatelet therapy should be discontinued 5-7 days prior to surgery
- POISE-2 trial in 2014 demonstrated increased bleeding risk with ASA
  - Rate of MACE at 30 days was similar in groups taking aspirin through time of surgery vs those not on ASA (7.0 vs 7.1%)
  - Rate of major bleeding more common in ASA group (4.6 vs 3.8%)
- ASA can be resumed post-operatively when risk of major bleeding has passed
Medication Management – Anticoagulants

- Of the 2.5 million Americans on anticoagulation, around 10% will need temporary adjustments of their medication for a procedure.

- Adjustments to anticoagulation therapy depends on:
  - Risk of **bleeding**
    - Surgical risk – Low vs Intermediate/High bleed risk
    - Patient risk – HAS-BLED score
  - Risk of **clotting**

- 2017 ACC Expert Consensus Decision Pathway for Periprocedural Management of Anticoagulation in Patients With Nonvalvular Atrial Fibrillation
Medication Management – Anticoagulants

• **Step 1:** Determine if the procedure is low bleed risk or not
  • Low bleed risk generally considered less than 2% chance of a major bleeding event in the perioperative period
  
• No changes to anticoagulants are necessary for procedures with low bleeding risk
  • **Dental procedures**
    • Low risk GI procedures – upper endoscopy with biopsy, colonoscopy (without polypectomy), diagnostic ERCP, biliary stent insertion, push enteroscopy, capsule endoscopy
    • Low risk surgery – cataracts, venogram, joint aspiration, skin procedures, bone marrow biopsy, pacemaker placement, diagnostic cath, carpal tunnel release
Medication Management – Anticoagulants

- **Step 2a**: Quantify patient risk of major bleeding
  - Use the HAS-BLED algorithm for patients with AF
  - Score of 3+ considered significant
    - Hypertension
    - Advanced renal disease
    - Liver disease
    - Stroke history
    - Prior major bleed
    - Labile INR
    - Age >65
    - Use of meds affecting bleeding
    - Alcohol use

- https://www.mdcalc.com/has-bled-score-major-bleeding-risk
Medication Management – Anticoagulants

- **Step 2b**: Identify other patient-specific factors for risk of bleeding
  - Prior bleed event within 3 months (including intracranial hemorrhage)
  - Platelet abnormality (quantitative or qualitative)
  - INR above therapeutic range at time of procedure
  - Bleed history from previous bridging
  - Bleed history with similar procedure
Medication Management – Anticoagulants

- **Step 3**: Determine thrombotic risk for patients with increased risk of bleeding (>2%)

Thrombotic risk depends on

- **Underlying risk factors** (CHA2DS2-VASc)
  - Age
  - Sex
  - CHF (EF <35%)
  - Hypertension
  - Diabetes mellitus
  - Vascular disease
  - Prior TIA/CVA/VTE

- **Indication for AC**
  - Mechanical heart valve
  - Atrial fibrillation
  - History of VTE

Medication Management – Anticoagulants

▪ Patients with LOW thromboembolism risk can stop ACs per guidelines
  ▪ Bileaflet mechanical aortic valve with no risk factors
  ▪ Atrial fibrillation with low CHA2DS2-VASc score (<=4) and no TIA/CVA
  ▪ VTE (single) >12 months ago with no known thrombophilia

▪ Patients with HIGH risk need bridging if on warfarin
  ▪ Mechanical mitral valve or older style aortic valves
  ▪ Atrial fibrillation with high CHA2DS2-VASc score (>=7), rheumatic heart disease, or stroke/TIA <3 months ago
  ▪ VTE <3 months ago or severe thrombophilia

▪ Patients with INTERMEDIATE risk may benefit from bridging depending on patient preference and bleeding risk
Medication Management – Anticoagulants

- Stopping ACs before surgery depends on medication, risk of bleeding with the procedure, and renal status
- DOACs should be stopped longer if spinal anesthesia or procedures are performed (3-5 days)
- Typically can resume 24-72 hours after procedure

<table>
<thead>
<tr>
<th>Medication</th>
<th>Hold</th>
<th>Resume</th>
</tr>
</thead>
<tbody>
<tr>
<td>warfarin (Coumadin)</td>
<td>3-7 days prior to surgery depending on INR at 5-7 days prior to procedure; recheck INR 24 hours prior</td>
<td>12-24 hours after surgery (often evening of)</td>
</tr>
<tr>
<td>dabigatran (Pradaxa)</td>
<td>Hold 3-5 days for CrCl &lt;80; 24 hours before low bleed risk surgery; 48 hours before high bleed risk surgery</td>
<td>Once patient is ready for FULL anticoagulation. Start 2 hours before next LMWH dose or when UFH drip is stopped</td>
</tr>
<tr>
<td>rivaroxaban (Xarelto)</td>
<td>24 hours before low bleed risk surgery; 48 hours before high bleed risk surgery</td>
<td></td>
</tr>
<tr>
<td>apixaban (Eliquis)</td>
<td>24 hours before low bleed risk surgery; 48 hours before high bleed risk surgery</td>
<td></td>
</tr>
</tbody>
</table>
Medication Management – Anticoagulants

- Bridging is typically only needed for patients on warfarin at very high risk of thrombosis

- ORBIT-AF registry looked at patients with atrial fibrillation who had temporary interruption of ACs for procedures
  - Patients who had bridging were 3x as likely to have a major bleed and 2x as likely to have a MACE

- If decision is made to bridge, check creatinine to assess GFR
  - Increased bleeding risk with enoxaparin (Lovenox) with CrCl <30

<table>
<thead>
<tr>
<th>Medication</th>
<th>Start</th>
<th>Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td>enoxaparin (Lovenox)</td>
<td>3 days prior</td>
<td>24 hours prior</td>
</tr>
<tr>
<td>unfractionated heparin</td>
<td>3 days prior</td>
<td>Evening before (SC) or 5 hours prior (IV)</td>
</tr>
</tbody>
</table>
Medication Management – NSAIDs

- NSAIDs inhibit COX-1 which increases bleeding risk
- Platelet function tends to normalize within 3 days for most NSAIDs
- Ibuprofen may have even less impact on platelet function
- Typically holding NSAIDs at least 3 days is recommended
Medication Management – Beta Blockers

- Initial enthusiasm for beta blockers dropped with results of POISE trial
  - Patient started on metoprolol immediately before surgery had higher stroke risk and overall mortality.
  - Cause of increased deaths thought possibly related to hypotension
  - Beta blockers should not be started on the day of surgery (LOE B)

- Current guidelines recommend patients chronically on beta blockers should continue them (LOE B)

- Patients with 3 or more cardiac risk factors may benefit from initiation of beta blockers before surgery (LOE B)
Medication Management – Alpha-2 Agonists

- Alpha-2 agonists for prevention of cardiac events are not recommended (LOE B)

- For patients already on clonidine, abrupt cessation can produce rebound hypertension
  - Most common with doses over 0.8 mg or with transdermal form

- Given potential for rebound hypertension, continue but don’t initiate alpha-2 agonists
Medication Management – ACE-I/ARB

- Per 2014 ACC/AHA guidelines, continue ACE inhibitors or ARBs perioperatively (LOE B)

- If these meds are held before surgery, plan to restart as soon as clinically feasible postoperatively (LOE B)

- HOWEVER, a recent observational study (VISION) calls this advise into question
  - Of 4802 patients using ACE-I/ARB, 74% took the medicine within 24 hours of surgery
  - Outcome of death, stroke or MI occurred in 12.9% on med vs 12.0% off med
  - Intraoperative hypotension was lower in the drug-withheld group (23.3% vs 28.6%)
Medication Management – Diuretics

- Theoretical risk of hypovolemia and hypokalemia after surgery for patients on diuretics
- Study in 2010 did not increase risk of intraoperative hypotension
- Reasonable to hold diuretics and restart once patient is taking oral fluids
Medication Management – Cholesterol medications

- **Statins** should be **continued** for patients undergoing noncardiac surgery (LOE B)

- Patients undergoing vascular surgery may benefit from initiation of statins (LOE B)
  - **DECREASE-III** trial with fluvastatin (Lescol) significantly reduced cardiac complications in patients undergoing vascular surgery
  - Start at least 2 weeks prior to surgery

- **Non-statin** cholesterol controlling medications should be **discontinued** due to potential impact on GI system
Medication Management – Pulmonary medications

- Inhaled bronchodilators should generally be continued
  - Beta agonists
  - Anticholinergics

- Patients on inhaled or oral steroids should also continue these medications in perioperative period

- Leukotriene inhibitors also appear safe and should be continued

- Theophylline should be stopped the day before surgery
  - Supra-therapeutic levels can produce arrhythmias
Medication Management – Glucocorticoids

- Perioperative use depends on amount and duration of treatment
- Increased risk of suppressed hypothalamic-pituitary-adrenal (HPA) axis in patients who:
  - Have been on steroids > 3 weeks
  - Have been on doses > 20 mg/day
- Patients on doses of 5 to 20 mg/day may have a suppressed HPA axis and should undergo an evaluation with an AM cortisol after 24 hours off glucocorticoids
  - <5 mcg/dL → needs stress-dosed steroids for 3 days post-op
  - 5-10 mcg/dL → check cosyntropin (ACTH) stimulation test
  - >10 mcg/dL → continue current steroid level
Medication Management – Diabetes agents

- Oral agents should be held the morning of surgery
  - Sulfonylureas → risk of hypoglycemia
  - Metformin → contraindicated with renal hypoperfusion
  - Thiazolidinediones → risk of fluid retention and CHF
  - SGLT-2 inhibitors → risk of hypovolemia
  - GLP-1 analogs → impact GI motility
  - DPP-IV inhibitors → impact GI motility

- **Hold short-acting insulin** the morning of surgery

- **Basal insulin** can be continued for short (<2 hr) procedures
  - Consider reducing dose 10-20% if concerned about hypoglycemia

- Insulin infusion usually required for longer procedures
Medication Management – Hormonal agents

- Estrogen increases risk of thromboembolism
- Reasonable to continue OCPs for low risk procedures
- Discontinue OCPs 4-6 weeks in advance of intermediate or high risk procedures unless patient would have difficulty complying with alternatives
  - Check pregnancy test prior to surgery
- Hormone replacement therapy carries less risk with lower estrogen
  - Same recommendations apply for discontinuing 4-6 weeks prior
Medication Management – Psychotropics

- Tricyclics can have several potential negative impacts
  - Lower seizure threshold, prolong QT, increase arrhythmia risk
  - Consider tapering off low doses over 7-14 days if possible

- SSRIs have some increased bleeding risk
  - Consider tapering off over one month for procedures with very high bleeding risks that could be detrimental (CNS procedures) or who need to continue on ASA

- Lithium should be continued with close attention to lithium level, sodium level, and fluid status

- Antipsychotics should be avoided in patients with prolonged QT

- Benzodiazepines should be continued due to withdrawal issues
Medication Management – Rheumatologics

- Methotrexate can be continued provided normal renal function
  - Renal impairment should trigger a 2 week hold
- Sulfasalazine and azathioprine should be held one week prior
- TNF-alpha inhibitors should be stopped at least 2 weeks prior
  - Resume once wound is fully healed
Many herbal medications can have deleterious impacts and should be held prior to surgery.

<table>
<thead>
<tr>
<th>Supplement</th>
<th>Potential side effect</th>
<th>Hold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Garlic</td>
<td>Increased bleeding</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Gingko</td>
<td>Increased bleeding</td>
<td>36 hours prior</td>
</tr>
<tr>
<td>Ginseng</td>
<td>Low sugar &amp; bleeding</td>
<td>7 days prior</td>
</tr>
<tr>
<td>Kava</td>
<td>Sedative</td>
<td>24 hours prior</td>
</tr>
<tr>
<td>St. John’s wort</td>
<td>Induces Cytocrome P450</td>
<td>5 days prior</td>
</tr>
<tr>
<td>Valerian root</td>
<td>Sedative</td>
<td>Taper over 2 weeks</td>
</tr>
</tbody>
</table>
Billing for consultation

- Must include 3 key elements ("three R’s")
  - Request from referring physician (must be documented)
  - Render opinion (cleared/not cleared, testing needed)
  - Report back to referring provider

- Medicare WON’T PAY for consultations
  - Must use appropriate office (9921x) or hospital (9922x) level E/M code
Summary

- Preoperative consultations offer you an opportunity to discuss potential risks with your patient.
- Risk depends on the type of procedure and health status of your patient.
- Use a validated risk algorithm to allow you to have an informed conversation with your patient and to guide potential interventions that may help mitigate risk.
- Review your patient’s medications for modifications prior to the procedure.
- Provide care that is appropriate to the patient regardless of the surgery proposed.